

SPECIFICATIONS FOR READYMADE BITUMINOUS POTHOLE PATCHING MIX USING CUT-BACK BITUMEN



**INDIAN ROADS CONGRESS
2014**



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Published by:

INDIAN ROADS CONGRESS

Kama Koti Marg,
Sector-6, R.K. Puram,
New Delhi-110 022

August, 2014

Price : ₹ 400/-
(Plus Packing & Postage)

IRC:116-2014

First Published : August, 2014

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Printed by India Offset Press, Delhi-110 064

1000 Copies

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SPECIFICATIONS FOR READYMADE BITUMINOUS POTHOLE PATCHING MIX USING CUT-BACK BITUMEN

1 INTRODUCTION

The draft “Specifications for Readymade Bituminous Pothole Patching Mix Using Cut-Back Bitumen” was prepared by Prof. P.S. Kandhal. The H-6 Committee deliberated on the draft and also noted the successful experience of the Rajasthan PWD and Jaipur Development Authority with the patching mix made to these specifications for repairing potholes. The Committee in its meeting held on 30th November, 2013 approved the draft document with certain modifications in the light of the comments and suggestions given by the members and authorized the Convener to refer the duly modified draft to the Highways Specifications & Standards (HSS) Committee. The modified draft was approved by HSS Committee in its meeting held on 7th January, 2014 and by the Executive Committee in its meeting held on 9th January, 2014 for placing before the Council. The Council in its 201st meeting held at Guwahati, Assam on 19th January, 2014 approved the document “Specifications for Readymade Bituminous Pothole Patching Mix Using Cut-Back Bitumen” for publication.

The Composition of H-6 Committee is as given below:

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Dr. S.S. Jain	-----	Co-convenor
K. Sitaramanjaneyulu	-----	Member Secretary

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Secretary General

(Kandasamy, C.), Ministry of Road
Transport & Highways

(Prasad, Vishnu Shankar),
Indian Roads Congress

2 SCOPE

The material shall consist of plant mixed readymade pothole patching bituminous mixture composed of mineral aggregate coated with bituminous material. The material shall be capable of being stocked for at least six months without stripping and shall be workable at all times. Unless specified otherwise, this mix shall be supplied in 50 kg plastic lined, sturdy bags. This material is intended for patching potholes up to 75 mm deep. For deeper potholes, patching mix shall be placed and compacted in 75 mm thick layers. Details on preparation of potholes, placing and compacting the mix in potholes are also given to ensure its effective use. The readymade cold patching mix is suitable for patching potholes only and shall not be used for patching long stretches of damaged road surfaces.

3 MATERIALS

3.1 Bitumen

Medium Curing Cutback Bitumen MC-800 conforming to Indian Standards Specification IS:217 Specification for Cutback Bitumen shall be used in preparing the patching mix and shall be supplied by a certified manufacturer of this product. For proper mixing, the bitumen shall be heated as specified in **Section 4**.

MC Cutback Bitumen shall be treated with a proper type and amount of an anti-stripping agent by the approved bitumen supplier so that when combined with the proposed job aggregate the resulting mix shall pass the Wet Coating Test, Static Immersion Test and

Water Resistance Test as given in **Appendix-I**. The anti-stripping agent shall Conform to IS:14982. The Contractor shall furnish the sample of the job aggregate each year to the bitumen supplier for these coating and stripping tests and obtain a certificate that the bitumen material has been treated to suit the job aggregate. This yearly certificate must be on file and shall be available at the asphalt mix plant when required by the Engineer. The Contractor shall also forward a copy to the Engineer. Under no circumstances, the Contractor or the department shall be permitted to manufacture the MC Cutback by blending paving bitumen and kerosene.

3.2 Coarse Aggregate

3.2.1 The coarse aggregate shall consist of crushed rock, crushed gravel or other hard material retained on 2.36 mm sieve. It shall be clean, hard, durable and cubical shape, free from dust and soft organic and other deleterious substances. The aggregate shall satisfy the physical requirements specified in **Table 1**.

Table 1 Physical Properties of Coarse Aggregate

Property	Test	Requirement	Test Method
Cleanliness	Grain size analysis	Max. 2% passing 0.075 micron	IS:2386 Part I
Particle shape	Flakiness & Elongation Index (combined)	Max. 35%	IS:2386 Part I
Strength*	Los Angeles Abrasion Value	Max. 40%	IS:2386 Part IV
	Aggregate Impact Value	Max. 30%	IS:2386 Part IV
Durability	Soundness (Sodium or Magnesium), 5 cycles		
	Sodium Sulphate	Max. 12%	IS:2386 Part V
	Magnesium Sulphate	Max. 18%	IS:2386 Part V
Water Absorption	Water Absorption	Max. 2%	IS:2386 Part III

* The coarse aggregate may satisfy either of the two strength tests.

3.2.2 Where crushed gravel is proposed for use as aggregate, not less than 90 percent by weight of the crushed material retained on 4.75 mm sieve shall have at least two fractured faces resulting from crushing operation.

3.3 Fine Aggregate

Fine aggregate shall consist of crushed mineral material passing 2.36 mm sieve and retained on 75 micron sieve. It shall be clean, hard, durable, and free from dust and soft organic and other deleterious substances. No natural sand shall be permitted.

3.4 Composition of Mixtures

When tested in accordance with IS:2386 Part 1 (wet sieving method), the combined aggregate grading shall fall within the limits shown in **Table 2**. As far as possible an aggregate with

water absorption of 1.0 or less shall be used. The amount of residual bitumen binder (total cutback bitumen minus diluent such as kerosene) in the mix shall be as shown in **Table 3**. The readymade patching mix shall be rejected if it does not meet the grading (especially the 0.075 mm sieve) and the minimum residual bitumen content. The produced mix shall be tested by an independent approved testing laboratory before its acceptance by the Engineer.

Table 2 Gradation of Stockpile Patching Mix

Sieve Size, mm	Percent Passing
9.5	100
4.75	40 – 100
2.36	10 – 40
1.18	0 – 10
0.075	0 – 2

Table 3 Minimum Residual Bitumen Content by Weight of Mix

Aggregate water absorption, %	Minimum residual bitumen content, %
Less than 1.0	4.5
1.1 to 1.5	5.0
1.6 to 2.0	5.5

Based on the characteristics of the aggregate and the performance of the mix, the Engineer can specify amount of residual bitumen higher than that shown in **Table 3**.

The Contractor shall ascertain from the supplier of MC-800 as to how much residual bitumen it contains. For example, if the MC-800 contains 80 percent bitumen and 20 percent kerosene and a total of 6.0 percent MC-800 is used by weight of the mix, the residual bitumen content in the mix will be 4.8 percent.

4 PREPARATION AND STORAGE OF MIXTURE

The readymade patching mix shall preferably be produced in a conventional batch type hot mix plant. However, if a portable or stationary asphalt drum plant is used, under no circumstances drying/heating of aggregates with a burner flame and mixing with MC-800 shall be carried out simultaneously because MC-800 containing volatile kerosene will catch fire and pose a safety hazard. The Contractor and the Engineer shall ensure there is no open flame inside or outside the drum when MC-800 is added for mixing.

The mix should be such that it can be stocked, handled, placed, and finished without stripping of the bitumen from the aggregate. To help prevent stripping and avoid heat buildup in a stockpile (which may burn the entire stockpile due to chimney effect), the mixed material should not be stockpiled not higher than 1.5 m for the first 48 hours. The stockpile then can

be raised in height and made conical in shape. Unless specified otherwise, the readymade cold mix shall be placed and sealed in plastic lined, sturdy 50 kg bags on cooling.

The mineral aggregate should be clean and surface dry before mixing. The temperature of aggregate and bituminous material should comply with those shown in **Table 4**.

Table 4 Temperature Ranges for Producing Stockpile Patching Mix

Bituminous Material	Aggregate Temperature, °C	Bitumen Temperature, °C
MC-800	25 – 65	75 - 95

Since the range of aggregate temperature is rather low and the maximum aggregate temperature is restricted to 65°C, it may not be possible to dry the aggregate within this temperature range. Therefore, the aggregate can be processed in a dryer at high temperatures and allowed to cool before the bituminous binder is added. Pre-drying the aggregate at high temperatures will also help in reducing the fines (material passing 0.075 mm sieve), which will go into the bag house. The resulting mix then would have fines less than 2 percent as required in the stringent gradation specifications.

High aggregate temperatures while mixing with the cutback bitumen will not only cause excessive loss of kerosene from the cutback but will also pose a safety hazard in the plant pug mill. Proper and adequate venting of the pug mill is necessary. Under no circumstances there shall be any open flame in the vicinity of MC-800 cutback because it contains volatile kerosene.

Since the mix contains volatile kerosene it is not safe to store the loose mix or sealed bags in a closed building/warehouse. Store under an open shed or in a well ventilated warehouse. No open flame or smoking shall be allowed in the vicinity of the stored mix.

5 PREPARATION OF POTHoles, PLACING AND COMPACTING OF READYMADE POTHOLE PATCHING MIX

5.1 Preparation of Potholes

Pothole shall be cleaned with a stiff wire brush and all loose material including dust shall be removed with a soft brush. Pothole need not be dry. However, excess water shall be swept off the pothole.

5.2 Placing Mix in Potholes

The mix is intended for patching potholes up to 75 mm (3 inches) deep. For deeper potholes, patching mix shall be placed and compacted in 75 mm thick layers.

If the pothole is deep and extends to WMM or granular base, it is recommended to apply a suitable tack coat or prime coat as feasible before placing the patching mix. If angular aggregate (nominal size 25 mm) is used to partially fill deep potholes, the aggregate should

be compacted thoroughly and primed with MC-30 before placing the patching mix. At least 50 mm thick pothole patching mix shall be placed at the top.

5.3 Compacting the Mix

First the outside edge or periphery of the patch shall be compacted with a hand rammer/small compactor and then compaction shall proceed inwards. To prevent initial pick up of the loose mix by the hand rammer either continue to wet the hand rammer with water or place empty plastic lined bags on the loose mix.

For deep potholes, place the patching mix and compact in 75 mm thick layers. After compaction, the compacted patch shall be slightly proud of the existing road surface to allow for further compaction by traffic.

If there are numerous closely spaced patches, it is preferred to use a small roller rather than a hand rammer. If a roller is used, the mix shall be placed and spread slightly proud of the surface so that after rolling the compacted surface shall be flush with the adjoining surface.

5.4 Applying Sand to Prevent Pick up by Traffic

Before opening the compacted patch to traffic, sufficient amount of clean sand shall be sprinkled on the patch to prevent pick up by traffic.

6 QUALITY CONTROL AND ACCEPTANCE OF MIXTURE

The composition of the produced mix (gradation and bitumen content) shall be tested by an independent, approved testing laboratory before acceptance by the Engineer. Before conducting the bitumen extraction test to determine residual bitumen content in the patching mix, the sample shall be cured completely to remove all kerosene. Curing shall be done as follows. Place the loose mix in an open metal container and heat slowly on a hot plate with frequent stirring until a constant weight is achieved.

The following two tests shall be performed by the Contractor (in presence of a department representative) on the mixture, freshly prepared or taken from a stockpile or sealed bag at any time during its storage life (usually 6 months).

- i) Water Resistance Test (See **Appendix I**, Test C)
- ii) Workability Test (See **Appendix I**, Test D)

The water resistance test would indicate whether the patching mix has a potential for stripping in the pothole in presence of water. If the mix fails this test, it means a proper type and/or amount of an anti-stripping agent has not been used in the bituminous binder.

If the mix fails in workability it could be due to improper bitumen type, low bitumen content, excessive fines or improper gradation. Even one-half percent lower bitumen content can make the patching mix unworkable and useless.

Stocked patching material may be rejected, at any time during the six months period if, in the opinion of the Engineer, the patching material has stripped (more than 10 percent uncoated particles) or otherwise become unfit or unworkable for use.

Appendix-I
(Refer Clause 3.1)

A Wet Coating Test (Clause 3.1)

Heat the unwashed job aggregate, cutback bitumen and distilled water to 40°C in a suitable oven. Weigh 100 g of dry aggregate into a suitable mixing container (such as seamless tin can, 16 oz capacity). Add 3 ml of distilled water. Mix thoroughly with a spatula until the aggregate particles are uniformly wetted. Add cutback bitumen equivalent to 5.0 +/- 0.2 g of bitumen residue. Mix rigorously with the spatula until all aggregate is coated, but not more than 5 minutes. Transfer the contents into a 400 ml beaker containing 150 ml of distilled water (22 - 32°C). Let stand for 15 minutes and visually determine the percent of retained coating, which should be at least 98 percent.

B Static-Immersion Test (Clause 3.1)

The coated aggregate as prepared in the preceding Wet Coating Test shall remain immersed in the beaker of distilled water (22 – 32°C) for 24 hours. At the end of this period, visually determine the percent of retained coating while the sample remains immersed in water, which should be at least 95 percent.

C Water Resistance Test (Clause 3.1 and 6)

Fifty grams of patching mix, whether freshly prepared or taken from the stockpile or a sealed bag, shall be heated at 120°C in a laboratory oven for 1 hour, cooled to 95°C in laboratory air, and then placed in 400 ml of boiling water in a 600 ml glass beaker and stirred with a glass rod at the rate of 1 revolution per second for 3 minutes. The water shall be decanted and the mix shall be spread on an absorbent paper for visual observation of the coating. The aggregate shall be at least 90 percent coated with a bituminous film.

D Workability Test (Clause 6)

Approximately 2.5 kg of the patching mix shall be cooled to -7°C in a freezer. After cooling, the mixture shall be capable of being broken up readily with a spatula that has a blade length of approximately 200 mm. This test shall be performed when the mix is produced and thereafter anytime during storage. If the mix is not workable at -7°C, it shall be rejected and the composition of the mix shall be properly modified (for example, by increasing the bitumen content and/or gradation changes). This test is also applicable in areas with hot climate because it amplifies the workability characteristics of the mix by using a lower test temperature.

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- 1) Kandhal, P.S. and Mellott, D.B. Rational Approach to Design of Bituminous Stockpile Patching Mixtures. Transportation Research Board, Transportation Research Record 821, 1981.
 - 2) Kandhal, P.S. A Simple and Effective Method of Repairing Potholes in India. Journal of the Indian Roads Congress, Volume 69-3, October-December 2008.
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(The Official amendments to this document would be published by the IRC in its periodical, 'Indian Highways' which shall be considered as effective and as part of the code/guidelines/manual, etc. from the date specified therein)